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Japanese Published Examined Patent Application (Kokoku Koho) No. S48-34224, Patented Date: October 19, 1973; Application No. S45-116727; Application Date: December 24, 1970; Int. Cl.: A23l 1/20 A23j; Inventor(s): Akio Uno et al.; Applicant: The Nissin Oil Mills, Ltd.; Japanese Title: Daizu Tanpakushitsu Youeki no Kanetsu Houhou (Method for Heating of Soybean Protein Solution)

Brief Description of Drawings

Fig.1 illustrates a heater for a soybean protein solution by the invention.

Detailed Description of the Invention

This invention pertains to a heating method for a soybean protein solution. More specifically, the invention discloses a method for industrially continuously carrying out a heating of a solution that contains protein obtained from soybeans.

Japanese patents No. 318736 and No. 430915 disclose an improved product quality by the following means: sterilization of a soybean protein dispersion solution by a heating means; improving the digestibility; and deodorization. When these quality improving means are industrially carried out, various difficulties on the operation occur. The product deteriorates depending on the heating conditions. In detail, due to the heating of the protein solution, the viscosity rapidly increases to lower the workability and the work efficiency. At a certain heating condition, the deterioration of the quality including the dissolution and the gelling performance is accelerated during preservation of the product.

As a result of various studies on the heating condition by the inventors, they have achieved the purpose of sterilization and an improved quality by controlling the increase

heat
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of the viscosity that occurs at the heating process as much as possible, thereby establishing a streamlined heating method.

The invention is described hereinbelow with reference to Fig.1.

A relatively diluted solution that contains soybean protein is preheated through a heat exchanger 2 using a pump 1, and the preheated solution is then supplied to a mixing nozzle 4 via a check valve 3.

Pure steam is supplied to the preheated solution from a mixing nozzle 4; the temperature is instantaneously increased to 120 to 150°C; and the solution is then ejected to a vacuum chamber 7 via pipes 5 and 6 whose diameter and length are selected so that the temperature is maintained for 10 or less seconds.

Valve 6 is a pressure adjusting valve so that the heated solution is adjusted to be kept under a high temperature and a high pressure. Vacuum chamber 7 is maintained at a specific reduced pressure by supplying and circulating cooling water at a predetermined temperature to/in a barometric condenser 8.

The high temperature treatment solution that has continuously flowed in vacuum chamber 7 via pressure adjusting valve 6 in a cut-line direction along the can wall and that has been modified by sterilization collects, concentrates and cools the steam supplied for heating. The steam is also instantaneously cooled.

At the time, a volatile odorous component is removed under a reduced pressure by a diluting means. The treatment solution in vacuum chamber 7 is extracted with an extraction pump 10, heated by heat exchanger 9, returns to the vacuum chamber, and finally evaporates the supplied water content along the can wall.

By repeating the operations, the solution is concentrated up to a predetermined protein concentration while the increase of the viscosity is prevented.

The circulation solution is partially extracted to be used at a spray-drying process and the like.

The following solutions are included in soybean protein solutions that receive the heating treatment at the invention: an isolated protein solution; a neutral dispersion solution of concentrated protein wherein a whey portion is removed using an alkaline earth metal salt such as acid or calcium chloride; a concentrated protein solution wherein a lees portion is removed by a water or alkali extraction means; and a suspension solution obtained by adding water to a soybean (or concentrated soybean) powder.

The heating period for the steam using pipe 5 is determined so that the plate count becomes zero in relation to the temperature.

Table 1 indicates the comparison between a direct heating by the invention and an indirect heating by a plate heater according to the viscosity of an isolated protein solution and the quality of a powder obtained after drying the solution. The concentration of the protein solution at the heating is adjusted to 120%, and the pH to 7.0.

Table 1

	Conditions wherein the plate count becomes zero		Solution viscosity after heating	Quality of the powder product	
	Heating temperature	Period	(25°C) cps	Gel forming performance	Dissolution retainability
Direct Indirect		10 seconds		Sufficient	Sufficient
Indirect Heating		40 minutes			Insufficient

Based on Table 1, it is identified that the method of the invention prevents the increase of the viscosity and has an effect on the dissolution retainability.

A long term operation is not possible due to an adhesion of scales when the solution is indirectly heated at a high temperature for a short period of time.

As for the preheating performed by heat exchanger 2 of Fig.1, if the temperature of the stock solution is low, a large amount of steam is required when the solution is directly heated, thereby becoming necessary to increase the preheating temperature as much as possible. 70°C is the limit for a long term heating because the workability and the quality (particularly the dissolution retainability) are affected.

As similar to above, the heating operation by heat exchanger 9 is also preferably performed at 70°C or lower as a 70°C or higher temperature causes to deteriorate the quality.

As in the method of the invention, it becomes possible for the protein concentration, which previously has difficulty on the workability and the quality, to be highly concentrated at about 18 to 20% without having any adhesion of scales by using a concentrating method using a vacuum chamber.

The invention is described hereinbelow with reference to the working examples.

Working Example 1

A protein curd obtained from low denatured nonfat soybeans by using a conventional method is gelled to forma soybean protein solution of a 12% protein concentration at a 7.0 pH. After the soybean protein solution has been supplied to a heat exchanger at 112.5 Kg/hr, it is supplied to a mixing nozzle while it is preheated to 60°C. By blowing steam at a 5 Kg/cm^2G pressure using the mixing nozzle, the temperature is instantaneously increased to 140°C. The temperature is kept for 4 seconds to apply

sterilization and reforming. After that, an injection concentration is applied in a vacuum chamber that is adjusted at 710 mm Hg. At the time, water is supplied to a wastewater tank of a barometric condenser so that the water temperature becomes 40°C.

By extracting the concentrated protein solution (11.2% protein concentration) from the vacuum chamber, the solution is supplied in the heat exchanger with the 70°C water temperature running so as to obtain a 70°C solution. By repeating the injection into the vacuum chamber, a concentrated solution at a 14.9% protein concentration is obtained at a 90 Kg/hr ratio.

The apparent specific gravity of a powder that is obtained by spray-drying the protein solution is 0.37, and NSI thereof at 99%. Coloring is hardly seen, and sufficient shelf life is achieved.

Working Example 2

After adding water at 12 parts to finely pulverized low temperature extraction nonfat soybeans (90% NSI) at 1 part, the mixture is agitated at a high speed. The mixture is then heated to 40°C and sufficiently decomposed to obtain a suspension solution. The suspension solution is supplied into a device of Fig.1 and treated therein. More specifically, the solution is preheated to 70°C at the heat exchanger, steam is directly supplied to heat the solution to 130°C, the temperature is kept for 6 seconds to apply a heating treatment, and the solution is finally injected into the vacuum chamber and cooled therein. The treatment solution is extracted from the vacuum chamber to further increase the temperature up to 70°C, thereafter repeating the circulation at the vacuum chamber.

A part of the circulation solution concentrated at 12% is supplied in a spray-dryer and then dried by using a conventional method to obtain a powder product.

The following product analysis values are obtained: 6% water content; 48.5% protein; 88% NSI; and 200 pieces/g plate count.

Working Example 3

Nonfat soybean milk (4% solid portion; 6.5 pH), which is obtained by extracting a soluble portion from low temperature extraction nonfat soybean flakes (92% NSI) and by isolating a lees portion, is treated according to Working Examples 1 and 2 using the device of Fig.1. In detail, a concentrated solution treated at the following conditions is dried by using a conventional method to obtain a nonfat soybean powder with a sufficient flavor: a 70°C preheating temperature for the stock solution; a 140°C direct heating temperature; a 3 second retaining period; and a 15% concentration.

The following analysis values are obtained for the product: 8% water content; 62% protein; 90% NSI; and 200 pieces/g plate count.

Working Example 4

A low temperature extraction nonfat soybean powder (120 meshes) is suspended in water to obtain a 4.3 pH using hydrochloric acid. After removing a soluble portion (a whey portion), an insoluble portion is collected.

Water is added to the insoluble portion after it has further been rinsed with water. The water added insoluble portion is then agitated to neutralize it to prepare a dispersion suspension solution of an 8% solid portion at a 7.0 pH.

A heating treatment is applied to the suspension solution according to Working Example 2. After the treated solution has been dried, a concentrated protein powder with an improved flavor is obtained.

The following analysis values are obtained: 7% water content; 69.8% protein (by anhydride conversion); and a 300 pieces/g plate count.

Working Example 5

After cleaned and graded round soybeans has been rinsed with water and after they have been immersed in water for several hours, they are pulverized while adding water. After performing an extraction at 40°C while agitating the substance, the remainder (lees) is separated to obtain whole soybean milk (90% solid portion).

The whole soybean milk is treated using the device of Fig.1 according to Working Example 1. More specifically, the whole soybean milk is preheated up to 75°C using a plate heater, a steam treatment is applied at a 130°C heating temperature for an 8 second retaining period, the treated soybean milk is ejected into a vacuum chamber to instantaneously cool it, and the solid portion is finally concentrated to a 20% concentration.

At the time, a volatile ingredient of the soybean milk is removed to deodorize the soybean milk.

After the process, the soybean milk is spray-dried by using a conventional method to obtain a soybean powder at the following conditions: 5% water content; 47.8% protein; 20.5% oil; 90 NSI; and a 1000 pieces/g plate count.

Working Example 6

After cleaned and graded soybeans have been rinsed with water and after they have been immersed in water at a room temperature for 16 hours, the soybeans are pulverized with a grinder. After extracting a water insoluble portion at 40°C, the remainder (lees) is separated by a centrifugal means to obtain soybean milk (8.7% solid portion). The soybean milk is treated with the device of Fig.1. In detail, the soybean milk is supplied to a plate heater using a pump to be preheated at 70°C. Steam is then directly supplied to increase the temperature to 130°C. This temperature is kept for 10 seconds to give a heating treatment to the soybean milk. The heated soybean milk is injected into a vacuum chamber so as to prevent an excessive heat treatment. The injected soybean milk is instantaneously cooled while an increased portion by the water due to a steam supply is removed. By concentrating the soybean milk, it is discharged from the system in the form of a 10.1% solid portion.

A soybean curd (tofu) is produced using the treated soybean milk and gluconodectalactone [Translator's Note: the term is not located in any dictionary] and calcium sulfate as coagulants by using a conventional method.

The obtained soybean curd has a sufficient texture and flavor and a sufficient keeping quality at a lower plate count.

Claim

A heating method for a soybean protein solution, characterized in that, at a process for heating a solution that contains protein obtained from soybeans, the solution is preheated with a heat exchanger; the preheated solution is supplied into a pipeline

along with raw steam to heat it to 120°C or higher; after a predetermined sterilization and reforming has been applied while keeping for 10 or lower seconds selected according to the heating temperature, the treated soybean solution is injected into a vacuum chamber; a deodorization is applied evaporating the water content while a cooling is applied; the cooled substance is extracted with a pump and heated with the heat exchanger; the heated substance is returned to the vacuum chamber again; by repeating the aforementioned cycle, the substance is concentrated; and that a part of the substance is continuously extracted.

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